Testimony of Edward C. Bodmer

1. Q. **Please state you name, business address and occupation.**

A. My name is Ed Bodmer, my business address is 205 North Michigan Avenue, Suite 4315, Chicago, Illinois 60601. I am an economic and financial consultant specializing in matters related to the electric utility industry.

2. Q. **On whose behalf are you testifying and what is the subject of your testimony?**

A. My testimony for San Diego Gas & Electric Company ("SDG&E") provides comments on the report "Performance Evaluation of California Investor-Owned Utilities" (the "Report") prepared for Consumers Alliance for Electric Rate Reduction ("CAERR"). This testimony has been prepared by myself or under my direction.

3. Q. **Summarize your educational background and business and professional experience.**

A. I received a B.S. degree in Finance (with highest honors) from the University of Illinois in 1979 and an MBA degree (with honors) from the University of Chicago in 1986. My regulatory experience began with my employment on the Accounting and Finance Staff of the Illinois Commerce Commission and has encompassed numerous assignments on regulatory subjects as a consultant. In a past position as a Vice President at the First National Bank of Chicago, I managed a credit analysis of all

energy loans which included transactions for electric and gas utility companies. I also directed a number of energy related financial advisory projects for bank clients. In my current practice I have completed assignments for financial institutions, utility companies, and government agencies involving industry re-structuring, forecasting, pricing, resource planning and performance evaluation. I have testified on a wide variety of subjects including regional cost-of-service, asset spin-offs, construction programs, optimal capital structure, rate design, and credit quality.

4. Q. **Do you have experience related to the evaluation of management performance for electric utility companies?**

A. Yes. In 1990 Professor George Tolley and I published an article in Public Utilities Fortnightly entitled "Utility Rate Comparisons and Management Efficiency". This article was cited prominently in the CAERR Report. Related work which I have embarked upon over the course of my career have included a number of projects related to valuation of electric utility assets and quantification of management performance. For example, I have valued electric utility transmission, distribution and generation assets as part of the review of options associated with expiration of a major municipal franchise; I have quantified the management performance of individual electricity distribution companies in New Zealand; I have testified on differences in value and cost-of-service between various regional areas of an electric utility; I have developed valuations for utility companies in the course of financial advisory work; I have testified on

financial matters in a dispute related to valuation of co-generation assets; and, for the past five years, I have developed a comprehensive database and detailed statistical models to evaluate the management performance of U.S. electric utility companies.

5. Q. **What is the purpose and scope of your testimony?**

A. The purpose of my testimony is to critique the CAERR Report. The authors have purportedly used my methodology as a significant basis for their analysis.

6. Q. **Do you adopt the attached Report of Edward Bodmer as your testimony in this proceeding?**

A. Yes, I do.

EXECUTIVE SUMMARY BY EDWARD BODMER

On June 1, 1994 an organization called the Consumer Alliance for Electricity Rate Reduction published a report ("the CAERR report" or "CAERR study") suggesting that the three major California investor-owned utility companies are managed inefficiently. CAERR stated at pages 4-5 that it relied on statistical modeling techniques developed and published by Dr. George Tolley and myself, Edward Bodmer in a 1990 Public Utility Fortnightly article. My report, finds the following major flaws in the CAERR study:

- CAERR has failed to properly utilize the methodology that Dr. George Tolley and I developed and published.
- The modeling technique utilized by CAERR has significant analytical shortcomings and is not an appropriate technique to determine relative management or cost efficiency.
- If the CAERR report properly reflected the methodology that it claims to have used, then SDG&E's rates are 8% lower than the model's expected rates.
- The analysis performed in the CAERR report is so fragile that if it had been based on proper statistical methods and reflected state and local taxes, regional economic differences and fuel cost differences, then CAERR could not support the allegation that statewide rates are $6 billion too high. Consider:
  - ø Approximately $2.6 billion of the error is due to statistically and economically improper application of methodologies.
  - ø Approximately $2.7 billion of the error is due to omission of regional cost of living differences and improper accounting for capacity mix, such as coal and hydro.
  - ø Nearly $600 million of the error is due to the omission of state and local taxes.
  - ø All of the remaining difference is due to numerous other errors in the CAERR report.
- Unlike CAERR, which did not publicly release all its data and analysis, all data and equations used in my report are attached.

TABLE OF CONTENTS

REPORT FOR SDG&E ON PERFORMANCE EVALUATION OF THE CALIFORNIA INVESTOR-OWNED ELECTRIC UTILITIES FOR CONSUMER ALLIANCE FOR ELECTRICITY RATE REDUCTION

I. INTRODUCTION

My evaluation of the CAERR report[1] includes a conceptual review of the CAERR statistical models as well as independent replication of its results and correction of the flawed statistical analysis developed by ESC. My conclusions are that the CAERR report incorrectly interprets the results of inappropriate regression methods that contain numerous computational errors and omit important factors.

The CAERR report purports to apply an approach of modeling retail electricity rates using regression analysis which Professor George S. Tolley of the University of Chicago and I developed in 1990.[2] In this Tolley/Bodmer regression analysis we evaluated problems with drawing implications from electricity retail rate comparisons. We had found that unadjusted rate comparisons did a very poor job of evaluating utility company performance and we presented a method of separating retail rate elements, which are beyond management's control, from elements that could potentially be attributed to management quality. The framework we developed demonstrated that electric retail rate differentials are largely explained by costs inherent in serving a particular geographical area. Our approach also took into account that utilities make major

---

[1]I have not examined purported confidential cost data, information or equations in preparing this report. This material was not necessary to fully analyze the report because it was used by CAERR as secondary information to validate the nonconfidential rates comparisons. Moreover, the gross statistical and conceptual flaws found in the CAERR report led me to conclude that the confidential cost material would not be helpful. I was also able to utilize readily available cost date to verify my conclusions.

[2]George S. Tolley and Edward C. Bodmer, "Utility Rate Comparisons and Management Efficiency," Public Utility Fortnightly, January 4, 1990.

investments to serve customers needs at different times. Our method split the cost structure of electric utility companies into three causative factors -- service territory, regulation and management.

We found that the cost structure of an electric utility company is dependent on service area and regulatory factors. To account for inherent cost differences which arise from service territory constraints, we adjusted observed electric prices by variables which measure state and local taxes, customer cost structure, regional business operating cost, generating source availability and costs associated with serving urban as distinct from rural customers. We found that more than one half of the observed variation in electricity prices is explained by costs associated with selling electricity in different service territories.

In the electric utility industry, regulatory agencies generally set prices based on complicated legal regulations and historical accounting data. This means that electric rates not only are affected by basic cost structure, but also are the result of differing regulatory policies such as allowed rate of return and the age of capital assets. Our analysis suggested that 15 percent of variation in electric rates can be explained by regulatory factors. The remaining percentage of variations in electric rates could partially be explained by the quality of management.

The authors of the CAERR report assert that their study updates and applies this study. As I describe in more detail below, the CAERR report does not update our methodology but instead misapplies the approach and principles we articulated. The CAERR report incorrectly interprets results, uses inappropriate regression methods, omits important factors from regression equations, and

contains conspicuous numerical errors.

II. THE CAERR REPORT CONTAINS SIGNIFICANT ERRORS

A. A SUMMARY OF THE CAERR REPORT.

The CAERR report uses three sets of statistical models to evaluate the efficiency of the major California electric utility companies. These models are the "Industry 100 Rate Model", the "Top 30 Rate Model" and the "Top 30 Cost Model". The first two models (hereinafter, the "CAERR Models") are based on statistical analysis of comparative system average revenues (SAR) while the third model evaluates selected cost components. The Industry 100 Model is used to determine a group of the best performing electric utility companies which are then used in the Top 30 Rate Model.[3] This model, in turn, is used to quantify the dollar magnitude of inefficiencies incurred by electric utility customers in California. The Top 30 Cost Model is used to explain which aspects of utility operations and investments are resulting in a high SAR.

All three models purport to compute "management efficiency" by comparing actual rates (or costs) with rates (or costs) which are derived from a regression equation. These regression equations use a set of "explanatory variables" to establish "expected" rate and cost levels for each utility company. The difference between the actual retail rate and expected retail rate (the error term in the regression equation) is used as the efficiency standard. The statistical or regression equation which is the basis for the Industry 100 Rate has similar explanatory variables as the equation

---

[3]For judgmental reasons, the group of 30 companies is not the 30 companies with the lowest residuals from the Industry 100 Rate Model. Instead, six companies are deleted in establishment of the Top 30 Rate Model sample.

used in the Top 30 Rate Model.[4]

B. WHEN CAERR'S FLAWED REPORT IS CORRECTED, CALIFORNIA UTILITIES ARE NOT SHOWN TO BE INEFFICIENT.

The major problem with the CAERR model from an empirical standpoint is that explanatory variables which should adjust for service territory constraints and regulatory factors are incorrectly defined and/or excluded from the regression equations. In addition, factors under the control of management are erroneously included as explanatory variables. When obvious and basic corrections are made to the model so that variables account for service territory constraints and regulatory factors, the results dramatically change for the three major California utility companies. Examples of changes in variables which significantly impact results include:

- The tax variable used in the CAERR Models does not include state income taxes or local franchise taxes;
- The CAERR Models use actual salary costs which are under the purview of management rather than regional cost of living which captures external constraints in terms of the cost of doing business in a particular service territory;
- The CAERR Models do not differentiate between coal and other fossil capacity or account for hydro capacity which are often a function of the geography and infrastructure of a company's service territory;
- The CAERR Models use actual fuel cost, which is the result of management decisions, rather than the variables which account for the differences in fuel and purchased power cost, which arise from operating in different regions;
- The CAERR Models use a representation of plant age which does not adjust for accounting distortions;
- The CAERR Models do not account for differences in earned rate of return;
- The CAERR Models do not include load factor; and,

---

[4]The CAERR report states that the Top 30 Rate Model includes the same variables as the Industry 100 Rate Model", See pg. 7. However, CAERR's non-confidential documents reveal that two of the twelve variables are for some reason excluded.

- The CAERR Models do not consider environmental problems associated with large metropolitan areas.

To analyze the impact of problems with explanatory variables in the CAERR regression model I have re-run the CAERR Models and then substituted corrected variables for those used in the CAERR report. I have developed this analysis both for the Industry 100 Rate Model sample of companies used over the time period 1987-1992 used in the CAERR study and for an updated set of data which includes the year 1993. The results of this analysis in terms of expected versus actual rates are shown in Table 1 below.

The error terms in Table 1 are the average residuals over the six year period from 1988 to 1993. It is appropriate to use more than one year in examining residuals because the error term for a single company in a single year can be affected by weather, extraordinary plant outages, sudden fuel price swings and other temporary factors.

TABLE 1
CORRECTIONS TO THE CAERR MODEL

Regression Equation Description	CAERR Variable	Corrected Variable(s)	Reason For Correction	Actual vs. Expected Rate For California Electric Utility Companies 6 Year Average 1988-1993 (Cents Per KWH)		
				SDG&E	PG&E	SCE
CAERR Equation	Variables Discussed in CAERR Report	--	--	-0.04	1.65	1.53
CAERR Equation With Corrected Tax Rate	Taxes Other Than Income/KWH	Taxes Other Than Income Plus State Taxes and Franchise Fees	State and local tax differences include state taxes and franchise fees.	-0.48	1.24	1.20
CAERR Equation With Corrected Cost-of-Living Index	Salary Plus Pension Cost Divided by Electric Employees	Regional Housing Index and Regional Food Index	Salary costs reflect management decisions and alternative personnel deployment	-0.76	-0.18	0.38
CAERR Equation With Corrected Capacity Mix	Steam Percent, Nuclear Percent, Purchased Percent	Hydro Percent, Coal Percent, Nuclear Percent	Hydro and coal are largely a function of the service territory.	-0.23	1.20	1.37
CAERR Equation Corrected to Reflect External Rather Than Internal Fuel Cost and Purchased Power	Actual Weighted Average Fossil and Nuclear Fuel Expenses	Expected Fuel and Purchased Power Cost Based on Regional Cost Differences and IPP Percent	The expected fuel and purchased cost measures factors which are not controllable by management.	0.21	0.51	0.47
CAERR Equation Corrected for Plant Age Definition	Accumulated depreciation divided by gross plant	Accumulated depreciation divided by gross plant adjusted for book depreciation rate and net plant cost.	If a company has a high depreciation rate or an expensive plant the "raw" age variable will be distorted.	-0.12	1.48	1.46
Corrected CAERR Model Including Above Corrections and Omitted Variables	None	Population Density, Population of Largest City, Load Factor, Rate of Return	Account for environmental problems associated with large metropolitan areas.	-0.75	-0.32	0.13

The data in this table provide the basis for the correction of the $6.4 billion amount developed in the CAERR report. The $2.6 billion error from use of statistical outliers is derived from comparing the top 30 Rate Model with the Industry 100 Rate Model residuals. The impact of correcting for taxes, cost of living, and the fuel price variables is based on the difference in residuals from the CAEER equation and the corrected models.

The table demonstrates that correction of very basic and obvious problems with the CAERR Models dramatically change the results. Unlike the CAERR Models, the corrected models are robust in that they show similar results under a variety of alternative reasonable equations. As I explain below, even these corrected modeling results do not demonstrate that California electric utility companies are inefficient from the standpoint of having actual retail rates which are higher than expected rates.

The remainder of this report describes details of my analysis of the CAERR study. The discussion is organized into three general sections: (1) theoretical flaws associated with CAERR's Report; (2) conceptual problems and numerical errors associated with the CAERR analysis; and (3) review of the top 30 rate and cost models.

C. GROSS THEORETICAL FLAWS ARE CONTAINED IN THE CAERR REPORT

1. CAERR Incorrectly Claims That Its Rate Models Represents Conditions In Competitive Markets.

CAERR asserts that it has developed "a methodology for estimating economic efficiency standards of electric utilities ... which approximates competitive markets" and that its analytical approach "provides regulators with a method of measuring efficiency which approximates competitive markets". (CAERR report, pg. 1). Further, the report intimates that only the most efficient electric utility companies in the industry should be allowed to earn a reasonable return.[5] These statements incorrectly suggest that comparative statistical analysis of system average revenues of

---

[5]For example, on page 7 of the CAERR report, ESC states: "If the California utilities had performed to the standard of the most efficient utility (Northern States Power), the SARs for PG&E, SDG&E and SCE would have been 6.0, 7.0, and 5.9 cents respectively. These calculations suggest that the actual California rates were far above the levels that could likely be sustained in a competitive market."

utilities with the lowest error term or differences between actual and modeled rates simulate conditions of a competitive marketplace.[6]

Despite these assertions, CAERR fails to establish any principled relationship between simulation of competitive market conditions and comparison of actual and modeled rates. There is, in fact, absolutely no theoretical basis for the assertion that pricing in a competitive market is based on an efficient frontier as measured by the performance only of the most efficient company in an industry. Four obvious problems with the CAERR's logic are discussed below:

(a) The CAERR Method And Its Report Relies On Arbitrary And Inconsistent Modeling.

In citing work on "one-sided distributions to represent random inefficiency" (Roberts testimony, page 6), CAERR states that the "random inefficiency assumption was inconsistent with the time-series cross-sectional data employed" in its study. Hence, the "decision was made to relax the stringency" of the "efficiency frontier for this Study." Simply put, CAERR's data set was abbreviated from 100 to 30 utilities.

The CAERR report's rationalization to limit the data set was extremely arbitrary and inconsistent with established statistical estimation procedures which, in this instance, would mandate the use of the full 100 utility data panel.[7] Furthermore, the academic

---

[6]The CAERR report does acknowledge that Professor George Tolley and I have never suggested that comparative statistics of rates can be used to directly simulate competitive markets:

> "The focus of the Tolley and Bodmer work was simply inter-utility comparisons and did not address the issue of developing efficiency standards that might give guidance in identifying cost structures required for survival in more competitive markets". (CAERR report, pg. 5).

[7]See, e.g., Schmidt, Peter, and Robin C. Sickles, "Production Frontiers and Panel

literature in measuring production frontiers, uniformly uses either measures of output or unit costs in the quantification of relative cost efficiency.[8]

(b) CAERR Fails to Recognize that Utility Rate Comparisons (Even if Statistically Adjusted) Are Mostly Based On Sunk Costs, Rather Than Marginal Or Replacement Costs As In A Competitive Market.

CAERR's suggestion that a comparison of system average revenues mirrors conditions in a competitive market violates the most elementary principles in microeconomics. Basic principles of supply and demand dictate that pricing in competitive markets is driven by the marginal cost -- not average or sunk costs -- of producing a product. However, retail rates of electric utilities are determined by revenue requirements which include sunk costs. Even if progressive jurisdictions like California implement marginal cost rate design, the total revenue requirement will determine system average rates and invalidate the type of comparison CAERR has attempted.

To the extent that this comparative rate analysis measures performance, the performance includes the cumulative impact of decisions which have been made over the lifetime of assets. Retail rates of electric utility companies are set by regulatory commissions which use rate base measured at its original (sunk) cost. Therefore, the effectiveness of capital spending decisions made in the past will appear in the difference between expected and actual rates because the book cost of assets is made up of

---

Data", Journal of Business & Economic Statistics, October 1984, pgs. 367-373.

[8] See, e.g., Nadri M. Ishaq, "Producer's Theory", Handbook of Mathematical Economics, Vol. II, edited by Kenneth J. Arrow and Michael D. Intriligator. North Holland Publishing Company, Amsterdam (1982).

historical capital investments. Accordingly, in contrast to the CAERR Report's assumptions, system average revenues of a regulated utility cannot mirror conditions in a competitive market.

(c) CAERR Incorrectly Assumes That Pricing In Competitive Markets Is Tied To Management Practices Only Of The Most Efficient Firms In An Industry.

CAERR advocates that pricing in competitive markets reflects only the performance of the most efficient firms in an industry. This is fundamentally wrong. Prices in a competitive market are determined by marginal cost of firms in the industry. Efficient firms earn economic rents, whereas inefficient firms earn less than the market return or cease operations. Economic theory originally developed by Nobel laureate James Tobin[9] demonstrates that performance of management can be measured by the relationship between replacement cost and market value. A high ratio of market value to replacement cost indicates efficient management and low ratio indicates poor management.

(d) CAERR's Rate Analysis Fails To Account For Non-Cost Elements Such As Reliability Of Service, Environmental Impacts, Or Non-Commodity Portions Of Service.

CAERR does not address the fact that electric utility companies produce many items of value which are not incorporated in the average retail revenue per kWh. Comparative rate models evaluate performance only in terms of relative level of rates while ignoring reliability differences, environmental impacts, and other value differences. Although the comparative cost analysis may be useful in some contexts, differences in the value of electricity which can arise from variation in reliability of service can significantly

---

[9] James Tobin, "A General Equilibrium Approach To Monetary Theory," Journal of Money Credit and Banking, February 16, 1969

distort results. Similarly, if one company is more environmentally responsible than another company or must comply with stricter environmental regulations, the value of these "externalities" will distort the error term, which supposedly represents management performance over matters it has control. Finally, if a utility company is subjecting customers to risks by using spot fuel markets or high debt leverage, the value of this risk variation unacceptably will not appear in the analysis.

2. The CAERR Report Incorrectly Specifies Regression Equations.

As I will demonstrate below, the CAERR analysis is very fragile because the results change dramatically by simply adding or correcting variable definitions. Its equations omit many important variables, such as differing environmental requirements, rate of return and other service territory factors. CAERR's equations also incorrectly define power source, fuel cost, tax and plant variables. These errors render CAERR's statistical results useless.

When Professor Tolley and I developed our methodology, we attempted to explain rate differences between electric utility companies using statistical analysis. We understood then that a statistical model can only be useful in explaining rates if the regression equation is reasonably defined. In creating the initial study, we emphasized that the regression equations should only include factors which cannot be influenced by management. We also emphasized the importance of not omitting factors from the models which explain rate differences. These simple principles have not been applied in the CAERR analysis.

If the regression equation of retail rates is not reasonably defined, a portion of the rate variation which is left "unexplained"

(i.e., the error term) will be caused by problems in the statistical analysis. For example, if the regression equation is constructed using average rates as the "dependent" variable and fuel cost per kWh as the only "explanatory" variable, the error term will include factors related to service territory, customer mix, and accounting influences in addition to past and current management performance. On the other hand, the error term will not account for management decisions involving the efficiency with which fuel is procured. In this instance, since fuel cost itself is a component of rates the regression amounts to modeling rates as a function of one of the components which is part of the overall rate. No useful information with respect to management efficiency can be derived from this type of mis-specified model. The CAERR definition of fuel and salary costs is an example of this kind of error.

If variables are omitted from the statistical analysis, if variables are incorrectly included in the regression equation, or if there are errors in the definition of variables, a portion of what is characterized as management performance (i.e., the error term) will actually include the influence of the "omitted" variable.[10] For example, if representation of earned rate of return, DSM, environmental factors, or reliability are not included as variables in the equation, the error term will be capturing the impact of these factors as well as management performance. The CAERR model

---

[10]If variables are related to management and not a component of rates (such as reserve margin percentage) an argument can be made that the variables should be included in the regression and then moved to the left hand side of the equation in computing performance. The reason for including these variables is that omitted variables can bias the coefficients of the non-omitted variables. If a variable which influences retail rates is omitted from the equation and if the variable is correlated with other independent variables, the coefficients on the remaining variables will be biased as will be the calculated residuals.

omits many obvious variables which explain rate differences that are not under the control of management. If a variable is incorrectly defined, the error term will include errors in the definition of the variable as well as management performance.

To evaluate the quality of a regression equation one should consider the theoretical validity of the equation, determine if the estimated coefficients are reasonable given a priori expectations, and ensure that the model produces similar results when other reasonable equations are specified. The statistical analysis cannot be described as "robust" or stable unless the results do not significantly change when individual variables are included or excluded from the equation and unless the statistical coefficients make sense on an intuitive basis. If the models are stable, it should also be easy to verify the results on an independent basis using similar data. Finally, it is important to emphasize that an implicit assumption of these models is that the relationship between explanatory variables and rates is the same across firms. The CAERR report fails these essential tests.

3. The CAERR Report's Conclusions Are Not Supported By Its Analysis

The CAERR report's use of comparative rate data demonstrates problems which arise from using low rate companies to derive implications about the cost structure of other electric utility companies. The Top 30 Rate Model and the Top 30 Cost Model generally compare the California utilities only with companies which are in the low rate group. Clearly, the comparison of companies such as SDG&E with companies like Kentucky Utilities, which exclusively utilizes inexpensive coal, and Montana Power, which has a very high proportion of hydro and inexpensive coal-fired

resources, is inappropriate.

The CAERR report presents selected retail rate comparisons prior to drawing implications from the statistical models. There is no question that PG&E, SCE and SDG&E have higher rates than many utility companies in the rest of the nation. This is not surprising given many of the characteristics of serving customers in the state of California. However, a more reasonable sample to use in evaluating rate levels for PG&E, SCE and SDG&E is retail rates for investor owned utility companies which serve the largest metropolitan areas in the country. Further, simple inspection of the utility companies with low rates and with high rates reveals basic characteristics which must be accounted for in a statistical model. The low rate utilities are dependent on coal and hydroelectric generation and generally do not serve large urban areas.

D. THE CAERR REPORT CONTAINS SIGNIFICANT CONCEPTUAL AND NUMERICAL ERRORS.

1. Necessary Variables Were Omitted In The CAERR Report Models.

If variables are omitted which contain information about the utility service area, operating characteristics or regulatory environment, the error term improperly will be capturing the influences of these variables. The regression model presented in the CAERR study does not include many obvious variables which are generally outside of the control of management and which impact rates.

The low residual of Northern States Power ("NSP") in the CAERR study illustrates how the error term of the statistical analysis can contain information about the company which was lost due to problems

with variable definitions and omitted variables rather than actual management performance. NSP has access to very low cost coal in the Northwest without incurring high transportation costs. It also has advantageous low cost purchase power contracts with Manitoba Hydro because of its transmission ties to Canada and old nuclear plants which are significantly depreciated. Further, in 1992 it was in the process of requesting a significant increase in rates. Not one of these attributes were captured in the CAERR models:

- The fossil generation variable for NSP in CAERR's equation does not differentiate its coal capacity from gas and oil fired capacity of other companies.
- The purchased power variable for NSP in the CAERR's study suggests high levels of purchased power are correlated with high rates but does not capture the availability of low cost purchased power.
- Inclusion of a nuclear power percentage suggests NSP should have relatively high rates even though its nuclear plants have low embedded cost because of their vintage.
- That NSP was requesting higher rates in 1992 is evidence that the CAERR models do not properly take into account rate of return.

2. The CAERR Report Incorrectly Specifies Variables In Its Analysis.

The "Industry 100 Rate Model" presented in the CAERR study contains fundamental errors in both specification of the regression equation used as a basis for computing expected rates and also in its definition of explanatory variables. The results presented in the report and SAR equations call into question the computational accuracy of the study. Problems with the model include biases from the CAERR report's choice of independent variables as well as variables which are omitted from the equation. Indeed, the regression equation definition reveals a fundamental misunderstanding of the basic premise of how statistical analysis

can be used as a screening tool to evaluate the relative performance of utility companies.

In this section I discuss conceptual problems with the variables used in the CAERR report as presented in the testimony of Bill Roberts. In the subsequent sections I describe omitted variables and I summarize results from verifying and correcting the model. The order of my review corresponds to the discussion of independent variables in the testimony of Bill Roberts. (Roberts testimony pgs. 9-11).

(a) Customer Characteristics

The first group of variables discussed in the CAERR testimony is average use per customer and the percentage of residential sales. The rationale for including average electricity use is that "this variable essentially captures the effects of weather." (Roberts testimony, pg. 9). Upon review of the nonproprietary work papers, it is apparent that the use variable represents residential use per customers rather than total use. While I agree that it is appropriate to consider the impacts of usage because many distribution and administrative costs are a function of the number of customers rather than their energy usage, I note there are potential statistical problems with this variable because of price elasticity of demand. For example, if the use per customer for a company is high because of low rates, and if the use variable is very significant because of price elasticity, then the regression equation can be distorted.

Notwithstanding concerns involving price elasticity, I believe it is reasonable to include residential use as an explanatory variable because of the increased importance of DSM. For example,

if one company implements relatively more DSM than another company, it will have lower electricity use per customer and higher retail rates, even though it could be providing the same amount of electricity service at the same cost to its customers. Therefore, the impacts of DSM can be partially incorporated in the regression by including residential use as an explanatory variable. I also agree that residential percentage should be included in the equation due to the higher cost of serving residential customers. This variable was used in the Tolley/Bodmer 1990 paper.

(b) Power Source Characteristics

The CAERR report uses nuclear generation percentage, fossil generation percentage and purchased power percentage to represent power source characteristics. I find the choice of these variables surprising given that the objective of using a regression model is to isolate performance which is not related to management decisions. Recall that if the error term represents management performance, the independent variables must reflect only factors which are not under the control of management.

Inclusion of a purchased power variable, less purchases from Qualified Facilities, violates the basic objective of the approach which I developed to measure expected rates as a function of non-management factors because the decision to purchase or build particular types of generating capacity is a basic management decision.[11] For example, the decision to build a nuclear power plant is one of the basic management decisions which is made by managers of electric utility companies and including a nuclear power

[11]Purchases from QFs properly are a function of non-management or regulatory factors.

generation variable removes impacts of this basic decision from the analysis. If nuclear generation or nuclear capacity percentage is included in the regression equation, results of the model must be interpreted as related to management performance given previous decisions to build nuclear plants.[12] While the percentage of purchased power and nuclear power are very questionable from a conceptual standpoint, the percentage of energy generation from hydro facilities is often a function of the geography of the service territory, and the percentage of coal fired capacity versus gas and oil capacity often reflects the lack of environmental constraints for certain utility companies and proximity to coal sources. For example, based on discussions with SDG&E personnel I understand that it would be extremely difficult to build a coal plant in SDG&E's service territory because of environmental problems and high transportation costs.

The steam generation percentage (which includes coal, oil and gas generation) and purchased power percentage (which includes both utility and non-utility or QF purchases) have obvious data problems because of being too aggregated. The steam percentage variable mixes companies which are primarily coal based with companies which have limited access to coal-fired generation due to transportation constraints or costs and environmental issues. Further, rationalization of data problems with these variables in the CAERR report is curious. For example, the CAERR report asserts that "use of percent coal, oil, natural gas and other technologies in place of

---

[12]If nuclear percentage is included to remove the impacts of the decision to build nuclear plants, the percentage of nuclear capacity rather than the percentage of generation should be used so that the residuals do not include management decisions involving capacity factors.

percent steam would most likely have resulted in more demanding (lower) SAR benchmarks for the California utilities." The absurdity of this statement is demonstrated by virtue of the fact that so many of the lowest rate utility companies are primarily coal-fired utility companies. Similarly, the CAERR report totally ignores involvement of federal and/or state government in encouraging non-utility generation when it states that QF contracts "were the results of business arrangements that were entered into by utility management.". (Roberts testimony, pg. 10)

(c) Fuel Cost and Plant Characteristics

The CAERR analysis employs "the real price of fuel used" and the average age of plants in this category. (Roberts Testimony, pg. 10). The real price of fuel is an obviously inappropriate variable which demonstrates how the CAERR report misapplies the basic principles of the approach. In addition, the explanation of why plant age should be included in the equation demonstrates a lack of understanding of the basic fact that electricity rates are based on the original cost of assets.

The real price of fuel per kWh generated is the result of plant heat rates, plant mix, plant availability and contracting acumen -- all of which are fundamental to the management of a utility company.[13] Furthermore, there are often tradeoffs between fuel cost and other costs such as purchased power cost, operation and maintenance costs and capital costs. This means that including the fuel cost per kWh as an explanatory variable removes any provision

---

[13]The CAERR analysis has a computational error in the formula for fuel cost. Instead of simply adding steam and nuclear fuel expense and dividing the sum by generation produced from steam and nuclear facilities, the CAERR formula incorrectly includes hydroelectric and gas turbine generation in the denominator and thus distorts the equation.

for fuel related efficiencies in the analysis and it also distorts the error terms because of tradeoffs between fuel cost and other costs. In addition, there are basic statistical problems with including a component of the dependent variable (fuel cost per kWh is a component of total rates) in the regression equation as an independent variable.[14]

The problem with using fuel cost per kWh as an independent variable is demonstrated by a simple example of two companies with alternative strategies with respect to deploying generating capacity. Assume one company has nuclear power and a low average fuel cost while another uses its own generation only for peaking requirements and, therefore, has a high average fuel cost. The average fuel cost, and, therefore, the expected retail rate for the second company will be much higher than the average fuel cost and the expected rate for the first company, even though companies could be equally efficient. This example demonstrates the obvious point that external factors rather than internal costs must be included in the regression model.

The second variable included in this section of Bill Roberts' testimony is the average age of plant which is computed by dividing accumulated book depreciation by the original cost of electric plant. (Roberts testimony, pg. 10). I agree that an age variable is appropriate to include in the regression model, but I emphasize that it must be defined carefully to avoid distortions from accounting biases. An appropriate age variable should be included

---

[14]Finally, if for some reason the fuel cost should be excluded from the rate calculation, it should be subtracted on a one for one basis from rates and the analysis should be of rates after fuel cost. In statistical terms, the coefficient would be restricted to 1.0.

in the model to reduce distortions in pricing which arise from original cost accounting. Since accumulated depreciation is deducted from rate base, an equally efficient old plant can have substantially lower prices than a new plant. The differences in rates in this instance reflect the timing of capital investments rather than the quality of management decisions.

Even though it is appropriate to include an age variable in the regression equation, CAERR's explanation of its variable is theoretically incorrect. Bill Roberts testifies that the age variable "account(s) for the higher operation and maintenance cost of older plants." (Roberts testimony, pg. 10). This statement has nothing to do with the actual reason the variable should be included in the regression equation.

I believe that the age variable (defined by the ratio of accumulated depreciation divided by net plant) must be adjusted to account for differing depreciation rates and differing plant cost. If a company has a relatively high depreciation rate it will tend to have a higher percentage of accumulated depreciation to gross plant which has nothing to do with age. Similarly, if a company has built a very expensive plant, the denominator of the variable --net plant-- will be inflated but not because of the actual age of plant. To account for these influences I use a two step process which first regresses age of depreciation rate and plant cost and than uses the residual as the adjusted plant age.

(d) Labor and Regional Business Costs

The CAERR analysis uses the real average wage rate as an explanatory variable in the regression equation (i.e., the total salary and benefit cost divided by the number of employees as an

explanatory variable). This approach removes any provision for wage rate related management decisions from the CAERR measure of management efficiency. Salary cost is a variable subject to management discretion and its exclusion improperly distorts the use of the error term as a measure of management efficiency.[15] Problems with the wage variable are evidenced by analysis of the CAERR data. The data demonstrates that SDG&E and SCE have lower than average wage costs even though they operate in a region of the country which has a high cost of living.

There is no question that regional business costs are an important factor to include in the regression equation as an explanatory variable as the cost of living is based on regional indices which are not influenced by actions of the utility company management. Although the CAERR Report astonishingly ignored this variable, my analysis includes a regional cost of living explanatory variable using a weighted average of the cost of housing and the cost of food in each service territory.

(e) State and Local Taxes

Retail electricity rates often include substantial tax payments to state and municipal government bodies. It is important to account for differences in state and local taxes in cross-sectional statistical analyses because taxes are simply transfer payments which have nothing to do with decisions made by managers of utility

---

[15] If a utility company is paying more than necessary to its employees, or if a company has the wrong mix of employees in terms of professional and non-professional staff, or if the utility company purchases services rather than doing work in-house, these may all reflect management performance and will be reflected in the average wage rate. For example, if one company contracts for high value added distribution functions, while another performs the work in house, the company with the in-house employees will have higher salary cost. CAERR should have accounted for these factors in the error term which supposedly represents management performance.

companies. However, I emphasize that the tax variable must include franchise fees and all state taxes including state income taxes, property taxes and revenue taxes. The variable used by CAERR includes only taxes other than income divided by retail sales to represent taxes. By not including franchise fees and state income taxes in the tax variable, the CAERR analysis is significantly distorted.

To correct the CAERR model, I defined the tax variable to include state income taxes and franchise fees. These variables have a significant relative impact on the California utility companies. For example, the tax rate for SDG&E is doubled. Further, since the state and local taxes are one-for-one transfer payments, the retail rate should subtract taxes per kWh so that the regression is after tax retail rates as a function of service territory constraints and other factors.

3. Examination Of Results Of The CAERR Report Illustrates Several Unreasonable Conclusions.

There are many anomalies which appear in the results of the CAERR report. For example, the CAERR report states that LILCO has an expected rate of 11.4 cents per kWh. However, CAERR's expected rate for PG&E, SDG&E and SCE are 7.8, 9.1 and 7.7 cents per kWh, respectively. Given the low residential use, high cost of living, significant environmental constraints and inability to use coal which exists for both LILCO and the California utility companies, the large difference in expected rates is counterintuitive.

One would expect the worst performing utilities in this type of study generally to be those companies which have a concentration of very high cost generating plants. These companies include Toledo

Edison (because of the Beaver Valley and Perry nuclear plants), Illinois Power (because of the Clinton unit), Public Service New Mexico (because of the Palo Verde plant) and United Illuminating (because of the Seabrook unit). It is surprising that PG&E and SCE have a higher error term than any of these companies with extremely high cost capacity. Replication and correction of the model does not confirm the accuracy of these counterintuitive results.[16]

4. Flaws Demonstrated By Attempts To Replicate The CAERR Model

In this section I describe the statistical results from attempts to replicate CAERR's Industry 100 Rate Model. Replication allows a researcher to understand the statistical techniques used in developing the model, to test the validity of the assumptions made, and provides a starting point to evaluate how the results would

---

[16]In addition to citing the article I co-authored with George Tolley, the CAERR study refers to an analysis prepared in 1990 by Justin Gordon. The Gordon analysis which was based on 1987 data included a ranking of all utility companies in the data set. Results of the Gordon analyses are radically different from the CAERR report in that it is more favorable to the three California electric utilities. Results of the Gordon analysis are completely inconsistent with results presented in the CAERR study -- SDG&E ranked 38th best out of 112 utility companies (compared with a ranking of 65th out of 100 in the Industry 100 Rate Model). Given the significant decline in SDG&E's costs from 1987 to 1992, the result for SDG&E implies that the two models are radically different. For PG&E, ranking was 22nd out of 112 in the Gordon analysis and 98th out of 100 in the Industry 100 Rate Model; for SCE, the Gordon ranking was 65th compared with the CAERR ranking of 99th.

	GORDON RANK	CAERR RANK
SDG&E	38/112	65/100
PG&E	22/112	98/100
SCE	65/112	99/100

change when basic flaws in the model are corrected. In addition, I wanted to determine if the results could be verified with an independent data base. The workpapers associated with the replication and verification exercise are included in the Technical Appendix.[17]

I have drawn two conclusions from my replication of the CAERR Models. First, utilizing an R-squared statistic I have concluded that CAERR's Industry 100 Rate Model explains significantly less than the 99.3% claimed by CAERR.

Finally, I performed a Wald test to determine if CAERR's arbitrary reduction or truncation of the panel data from 100 to 30 utilities is empirically warranted. This truncation implies that the weighted estimation used in the CAERR report assumes that the coefficients of the explanatory variables do not vary across utility companies. This test demonstrates that the parameter estimates in the two CAERR Models are significantly different from one another and that the coefficients for each may be unique. This finding provides empirical evidence that the truncation of the panel data is unwarranted and improper.

---

[17]Regression results for the updated CAERR 100 model were replicated using the final transformed variables as provided by CAERR. Replication of the coefficients reported by CAERR were achieved in two steps. First, the equation was run using ordinary least squares (OLS) estimation. Second, an ad hoc adjustment for non-constant variance (i.e., heteroskedasticity) across the companies was done using a technique called weighted least squares. The estimated coefficients, standard errors, and t-statistics for the constant and explanatory variables match to several decimal places the CAERR estimates. In addition, it should be noted that the estimated coefficients are close to those obtained using ordinary least squares. This is reasonable when one considers that OLS estimation in the presence of heteroskedasticity still yields unbiased estimates, albeit inefficient. Therefore, OLS estimation is used in the correction of CAERR's flawed statistical analysis..

5. Theoretical, Conceptual and Numerical Errors In "Top 30 Rate Model" Presented In The CAERR Report

The $6.4 billion amount the CAERR report attributes to inefficiency of the three California utilities is derived from its Top 30 Rate Model. However, this model contains conspicuous computational errors in addition to all of the conceptual and mathematical defects which exist with the Industry 100 Rate Model. The Top 30 Rate Model is described in the CAERR report as follows: "The Model includes the same variables as the Industry 100 Rate Model. The model structure can be interpreted as reflecting the average performance of the Top 30 companies." Since the structure of the model is the same as the Industry 100 Rate Model, the extremely serious problems described above for the Industry 100 Rate Model are all common to this model. Even if the conceptual flaws and the computational errors did not exist for the Top 30 Rate Model, the loss of information content which arises from truncating data violates elementary principles of statistical analysis.

The listing of companies included in the Top 30 sample demonstrates obvious problems with the model. First, virtually all of the companies are hydro or coal based. For example, four out of the 30 companies are subsidiaries of American Electric Power. Second, there are questionable companies included in the sample. Some other extremely curious results include: Commonwealth Edison, which has been included even though its rates are significantly higher than any adjacent utility; Rochester Gas & Electric which is involved in the Nine Mile Point Nuclear Plant; Cincinnati Gas & Electric and Dayton Power are included even though they incurred extremely high costs which have not been recovered for the Zimmer Plant (both companies in 1992 were requesting significant rate

increases); Consumers Power has relatively low rates, but at a cost of very high write-offs and hidden leverage incurred through purchased power contacts.

The CAERR report explains that "the ten service area factors in the Top 30 Utilities Rate Model accounted for 99% of the variation in SAR's across the Top 30 companies for the period 1987 through 1992." This is an absurd result which clearly demonstrates that there are basic errors in the model in addition to the conceptual problems. An R-squared of 99.3%, if true, would imply that the maximum level of rate variation is attributable to management performance is .7%. In other words, if the CAERR report is correct, 99.3% of rate variation has nothing to with the performance of managers of utility companies!

Computation of the dollar results in the top 30 model demonstrates obvious numerical flaws in the analysis. The CAERR methodology supposedly reflects the <u>average</u> performance of the 30 most efficient utility companies rather than the <u>single</u> most efficient company which may be a statistical outlier. If this is true, comparison of residuals in the Industry 100 Rate Model with the residual of the furthermost company residual should be significantly less than the number computed from the Top 30 Rate Model. In other words, for an individual company, the following inequality should apply:

Company Residual + Absolute Value of Extreme Residual < Top 30 Residual

However, inspection of tables from the CAERR report reveals that the Top 30 Rate Model yields results which are more extreme than the furthermost residual in the Industry 100 Rate Model:

TABLE 2
COMPARISON OF EXTREME RESULTS OF INDUSTRY 100 RATE MODEL
WITH RESULTS OF TOP 30 RATE MODEL
RESIDUALS IN CENTS PER KWH

	Industry 100 Residual	Absolute Value of NSP Residual	Total Residual Plus Extreme Residual	Residual In Top 30 Rate Model
PG&E	.2	1.6	1.8	1.8
SCE	2.5	1.6	4.1	4.2
SDG&E	2.8	1.6	4.4	4.4

The table demonstrates that the unexplained deviation in the Top 30 Rate Model is greater than the amount which would be derived from comparing the error term of the California utility companies with the lowest error term in the Industry 100 Rate Model. In other words, if the extreme outlier of the Industry 100 Rate Model were used to measure performance, the results would be of lower magnitude than those based on the Top 30 Rate Model.

From a statistical standpoint there is no basis for truncating the data and computing a regression equation on only a small (and biased) portion of the data. The concept of truncating data in developing a regression equation shows a fundamental lack of knowledge of basic statistical concepts. For example, assuming that system average rates vary as a function of residential percentage, it would be silly to ignore most of the data in establishing the nature of the relationship. In other words, there is no reason to expect that the companies with low error terms from the large sample will have a different relationship than the overall sample.

6. The Cost Model Compares SDG&E Against Utilities That Are Inappropriate For The Comparison.

CAERR presents the Top 30 Cost Model to supposedly explain which aspects of utility operations and investments are causing

relatively high rates. As with the two rate models, the Top 30 Cost Model is marred by numerous errors. Using rural and coal based utilities to evaluate the cost structure of California electric utility companies provides results that are meaningless. Finally, use of disaggregated data to analyze costs is invalid because of tradeoffs between cost categories (such as fuel expense and purchased power). According to the CAERR report "the Top 30 Utilities Cost Model was simulated to generate O&M expense and plant in service benchmarks for the California Utilities." (CAERR's report, pg. 11). There is no documentation in the report of the equations used in the analysis and there is no description of which variables have been used in alternative regressions[18]. Further, the analysis is based on the same general approach as is used in the Top 30 Rate and Utility 100 Rate Models. It includes the same problems related to mis-specification of equations, truncation of the data set and exclusion of obvious important variables.

In the cost model information, which was publicly disclosed, the largest source of asserted dollar inefficiency is from purchased power expenses, even though the CAERR report itself acknowledges that "the data was not available at the time of this study to segregate purchased power into separate categories." (CAERR's report, pg. 11). Evaluating purchased power costs of California utilities based on the purchase availability of coal-based and hydro-based regions is highly questionable. Other problems with the cost model include:

- The absurdity of the cost model is demonstrated by attempting to model SDG&E's power production expenses using primarily hydro and coal based utility companies in the top 30 sample;

[18] I have not reviewed confidential materials for the cost model.

- When evaluating cost-of-service it is essential not to ignore tradeoffs between types of operating expenses or capital costs in the statistical models;
- In projection of absolute levels, the cost models can produce distortions because of the constant term and the amount of cost in the statistical models; and,
- In projection of absolute levels, the cost models can produce distortions because of the constant term and the amount of cost variation picked up by the size indicator variables.

III. CORRECTIONS TO THE CAERR MODELS PRODUCE VASTLY DIFFERENT RESULTS

A. CORRECTIONS TO MODELING ERRORS.

I have previously described problems with the CAERR models in terms of definition of explanatory variables and omitted variables. In this section I summarize the impacts of correcting these flaws. To correct the CAERR model to reflect properly defined variables and to include previously omitted variables I have used the following four step procedure:

Step 1: Replace each of the problematic variables in the CAERR model with a corrected variable to isolate the impact of the incorrect variable;

Step 2: Replace all of the incorrect variables in the CAERR analysis with corrected variables and run the corrected regression with and without the nuclear percentage variable;

Step 3: Include omitted variables in the model from step 2 and run the regression with and without the nuclear percentage variable; and,

Step 4: Perform sensitivity analysis on the model from step 3 with respect to residential usage, expected fuel and purchased power cost, capacity mix and other variables.

Results from steps 1, 2 and 3 are described in Table 4 below, while the sensitivity analysis is discussed in the next section. Results are presented for the CAERR data set (99 companies from 1987

to 1992) and for an updated database (125 companies from 1982 to 1993).

I have examined the CAERR model using an updated data set as well as the CAERR data set for three reasons. First, the updated data set can be used to gauge results of the models using 1993, data which recently was made available by UDI. [19] Second, it is important to consider more than one year of data in comparing actual and expected results since the residual for a single year can be affected by unusual weather, extraordinary plant outages, fuel price swings and other similar factors. Third, use of a comprehensive data set on all companies with available data provides a test of how robust the results are with respect to expansion of the sample set.

[19]All of the data used in my review of the CAERR Report, which ESC has not required to be treated as confidential, is derived from sources compiled in a database I have developed over the past five years. In addition, I have utilized the Utility Data Institute (UDI) database, which is derived from the publicly available FERC Form 1, and is widely used in the electric utility industry. Unlike the CAERR Report, this and other data which I used as "explanatory" variables, the computer programs which develop the analysis and the regression equation outputs are included in the attached technical appendix.

TABLE 3

COMPARISON OF CAERR RESULTS WITH MODELS USING CORRECTED VARIABLES

(ERROR TERM IN CENTS PER KWH)

	CAERR DATA SET			UPDATED DATA SET								
	PG&E	SCE	SDG&E	PG&E			SCE			SDG&E		
	1992 Residual	1992 Residual	1992 Residual	1993 Residual	6 Year Residual	1992 Residual	1993 Residual	6 Year Residual	1992 Residual	1993 Residual	6 Year Residual	1992 Residual
1. CAERR Results	2.50	2.80	0.20									
2. DLS CAERR Model	2.11	2.12	0.20	2.20	1.65	2.04	1.65	1.53	2.00	-0.05	-0.04	0.08
3. Corrected Tax Rate	2.01	1.96	-0.23	1.89	1.24	1.74	1.33	1.20	1.58	-0.48	-0.48	-0.36
4. Corrected Cost of Living	0.78	1.12	-0.50	0.44	-0.18	0.14	0.38	0.38	0.73	-0.86	-0.76	-0.78
5. Corrected Capacity Mix	1.81	2.02	0.06	2.09	1.20	1.62	1.49	1.37	1.79	-.25	-.23	-.17
6. Corrected Fuel Cost	1.30	1.13	0.42	0.94	0.51	0.81	0.26	0.47	.71	.18	.21	.25
7. Corrected Plant Age	2.03	1.94	-0.18	2.12	1.48	1.98	1.56	1.46	1.90	-.15	-.12	-.04
8. All Corrected Variables With Nuclear Percent	0.25	0.54	-0.34	0.02	-0.41	-0.16	-0.42	-0.10	0.17	-0.88	-0.61	-0.69
9. All Corrected Variables Without Nuclear Percent	0.30	0.54	-0.38	0.05	-0.39	-0.14	-0.40	-0.07	0.18	-0.89	-0.60	-0.67
10. All Corrected Variables And Inclusion of Omitted Variables With Nuclear Percent	0.26	0.56	-0.47	0.13	-0.29	-0.05	-0.23	0.10	0.75	-0.96	-0.71	-0.80
11. All Corrected Variables And Inclusion of Omitted Variables Without Nuclear Percent	0.26	0.59	-0.51	0.12	-0.32	-0.07	-0.21	0.13	0.58	-1.03	-0.75	-0.81

Lines 2 through 7 of Table 3 show that the CAERR model results are very fragile. When basic and simple corrections are made to variable definitions the implications of the results with respect to the California utility companies change dramatically. For example, making obvious corrections to the tax variable reduces the CAERR inefficiency computation by nearly $600 million (the difference in the residual multiplied by retail sales for the three California utilities); and correcting the cost of living variable reduces the inefficiency computation by more than $1 billion. Of course, the different results also imply that the group of top 30 utilities is significantly different when the model is corrected.

Lines 10 and 11 of Table 3 demonstrate that a reasonable regression model of expected rates cannot be used to imply that California utility companies are inefficient. To the contrary, the model shows that SDG&E's actual retail rates are well below the level of expected rates over the five year period. PG&E's rates are almost exactly at the expected level. SCE's expected rates are less than 2% different from actual rates. These results in no way can be used to demonstrate inefficiency. Further, these results remain the same whether or not the model adjusts for the amount of nuclear in the resource mix.

B. SENSITIVITY ANALYSIS ON THE CORRECTED MODEL

In addition to correcting the CAERR analysis, I have developed sensitivity analyses to verify that results from the corrected model are robust. The sensitivity analysis tests how sensitive the model results are to the following items:

1) Sensitivity with respect to inclusion or exclusion of the expected fuel and purchased power costs;

2) Sensitivity with respect to load factor and population density;

3) Sensitivity with respect to the cost of living variables;

4) Sensitivity with respect to inclusion of the coal capacity percentage variable; and

5) Sensitivity with respect to an alternative definition of residential use which removes the impacts of price elasticity of demand.

Each of the sensitivity analyses, except the capacity mix sensitivity, is performed both with and without the nuclear percentage variable. Results of the sensitivity analysis are summarized on Table 4 below. As with Table 3, results are presented both for the CAERR data set and for the updated data set. The sensitivity results illustrate two key points. First, since none of the sensitivity model results come anywhere close to the CAERR model results, the CAERR study loses all predictive credibility. Second, since the models uniformly (but for one very minor exception) show that SDG&E's rates are below expected rates and show residuals for PG&E's and SCE's rates well below 1 cent per kWh, none of the sensitivity models can be used to conclude the California utilities are managed inefficiently.

TABLE 4
SENSITIVITY ANALYSIS ON CORRECTED MODEL
(ERROR TERM IN CENTS PER KWH)

	CAERR DATA SET			UPDATED DATA SET								
	PG&E	SCE	SDG&E	PG&E			SCE			SDG&E		
	1992 Residual	1992 Residual	1992 Residual	1993 Residual	6 Year Average Residual	1992 Residual	1993 Residual	6 Year Average Residual	1992 Residual	1993 Residual	6 Year Average Residual	1992 Residual
1. OLS CAERR Model	2.11	2.12	.20	2.20	1.55	2.04	1.65	1.53	2.00	-.05	-.04	.08
2. Corrected With Nuclear Percent	0.26	0.56	0.47	0.13	-0.29	-0.05	-0.23	0.10	0.35	-0.96	-0.71	-0.80
3. Corrected Without Nuclear Percent	0.26	0.59	-0.51	0.12	-0.32	-0.07	-0.21	0.13	0.38	-1.03	-0.75	-0.81
4. No Load Factor, Population Density With Nuclear Percent	0.24	0.52	-0.48	0.01	-0.41	-0.20	-0.41	-0.09	0.15	-0.93	-0.66	-0.78
5. No Load Factor, Population Density Without Nuclear Percent	0.31	0.52	-0.48	0.04	-0.39	-0.17	-0.39	-0.06	0.17	-0.93	-0.64	-0.74
6. No Cost of Living With Nuclear Percent	0.73	0.74	-0.39	0.80	0.29	0.59	0.11	0.41	0.70	-0.72	-0.53	-0.58
7. No Cost of Living Without Nuclear Percent	0.66	0.74	-0.44	0.74	0.23	0.53	0.11	0.42	0.71	-0.79	-0.57	-0.60
8. No Expected Fuel & Purchased Power Cost With Nuclear Percent	0.24	0.96	-0.65	0.00	-0.45	-0.20	0.17	0.41	0.67	-1.27	-0.93	-1.03
9. No Expected Fuel & Purchased Power Costs Without Nuclear Percent	0.26	1.00	-0.66	0.01	-0.43	-0.19	0.15	0.38	0.64	-1.22	-0.90	-1.02
10. No Coal Percent or Nuclear Percent	0.38	0.75	-0.21	0.08	-0.37	-0.13	0.29	0.06	0.31	-0.81	-0.59	-0.65
11. Alternative Residential Use Variable With Nuclear	-0.17	0.49	-0.09	-0.18	-0.65	-0.57	-0.34	-0.07	0.09	-0.50	-0.19	-0.43
12. Alternative Residential Use Variable Without Nuclear	-0.27	0.45	-0.06	-0.25	-0.74	-0.68	-0.35	-0.06	0.07	-0.55	-0.20	-0.42